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TECHNICAL REPORT

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DEVELOPMENT OF A COMBAT BOOT LAST
FOR
THAI AND VIETNAMESE MILITARY FORCES

(Final Report)

by

Douglas S. Swain

Sponsored by

Advanced Research Projects Agency

Washington, D.C.

May 1967

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760



Clothing and Organic Materials
Laboratory

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ARPA Order No. 267, Amendment 11
April 1964

May 1967

Clothing and Organic Materials Laboratory
U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts

FOREWORD

This report covers Phase II of a program to develop a combat boot last for Thai and Vietnamese Forces sponsored by the Advanced Research Projects Agency, Washington, D. C. under Order No. 267, Amendment 11.

Jones & Vining, Inc., Brockton, Mass. worked in conjunction with Natick Laboratories on this project. Mr. Richard J. McLean of Jones & Vining was the Contractor Representative. The contract was initiated and administered under the direction of the Clothing and Organic Materials Laboratory, with Mr. Douglas S. Swain acting as Project Officer.

S. J. KENNEDY
Director
Clothing & Organic Materials Laboratory

APPROVED:

DALE H. SIELING, Ph.D.
Scientific Director

W. M. MANTZ
Brigadier General, U.S.A.
Commanding

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ABSTRACT

This report covers Phase II of work accomplished by the U. S. Army Natick Laboratories, Natick, Massachusetts under Advanced Research Project Agency (ARPA) Order No. 267, Amendment 11 on "The Development of a Combat Boot Last for Thai and Vietnamese Military Forces."

The program was a joint venture conducted with anthropometric data on Thai and Vietnamese feet originating at the Natick Laboratories, and preliminary tests of lasts and footwear models developed from this study by Jones and Vining, Inc., Brockton, Massachusetts.

The Project Officer on this program from the Natick Laboratories, and the representative from Jones and Vining, Inc., were in Thailand and Vietnam from 24 March to 24 April, 1965 at which time they conducted fit and wear tests of combat boots manufactured over the newly-developed last.

The tests showed that 99 percent of the Vietnamese/Thai military personnel could be adequately fitted using the new last with minor modifications, which were made. Models and equipment to fabricate the boots were provided to Thailand and Vietnam, U. S. Military Assistance Command.

ARPA ORDER NO. 267, AMENDMENT 11

U. S. ARMY NATICK LABORATORIES

NATICK, MASSACHUSETTS

The Development of a Combat Boot Last
for
Thai and Vietnamese Military Forces

1. Purpose

To test the fit and durability of newly developed last and boot for Southeast Asian Forces (Thailand-Vietnam).

2. Scope

In accordance with ARPA Order No. 267, Amendments 6, 11 and 14, a two-phase contract was awarded to Jones & Vining Last Company. Phase I was carried out during period 26 October 1964 to 20 September 1965.* Phase II was conducted from 11 October 1965 to 20 January 1966. The objectives of Phase I of this study which pertain to the development and testing of the last were as follows.

a. Review and study of available data pertaining to the feet and footwear of Thai and Vietnamese soldiers and a visit to Army Installations at Ft. Lee, Virginia, Ft. Bragg, North Carolina, Ft. Benning, Georgia, and Ft. Belvoir, Virginia to conduct preliminary fitting trials on sample prototype boots. Any modification deemed necessary from the fitting trials to be accomplished at the contractor's plant.

b. Fabrication of lasts and footwear from the available and assembled data.

c. Visit to Thailand and Vietnam by contractor's representative and Government representative (NLABS Project Officer) to conduct fitting trials on the test footwear.

Subsequently, Phase II of this study was initiated under Amendments 11 and 14 of ARPA Order No. 267. These amendments provided for the development/fabrication of a quantity of master and turning last models for supply to both Thailand and Vietnam.

3. Actions Taken

The "Anthropometric Survey of the Royal Thai Armed Forces" dated June 1964 by Robert M. White, Anthropologist, of the Natick

*See Annex B

Laboratories and sponsored by Advanced Research Projects Agency, included six basic foot measurements of the Thai soldier. These measurements were:

a. Foot length - Measured as distance from back of right heel to tip of longest toe.

b. Instep length - Measured as distance from back of right heel to inner ball of foot (first metatarsal-phalangeal joint).

c. Foot breadth - Measured as maximum breadth of right foot.

d. Ball foot circumference - Measured as maximum circumference of right foot at widest point (distal ends of metatarsals).

e. Heel breadth - Measured as maximum breadth of right heel behind and below projections of ankle bones (malleoli).

f. Heel/Ankle Diagonal - Measured as diagonal circumference around right ankle, with tape passing under tip of heel and over instep at junction of foot and leg.

A similar group of measurements for the feet of Vietnamese soldiers were also presented to the contractor for study and analysis.

These data were analyzed jointly by personnel of the contractor and the NLABS Project Officer. In addition, plaster casts and photographs of Thai and Vietnamese feet were studied. It should be noted that photos and casts are required in addition to anthropometric measurements to develop a new last in order to determine the proper distribution and conformation of the wood on the last in accordance with anthropometric measurements. To use foot measurements only, a cylinder conforming to the measurements could conceivably be developed. This point should be considered in any future anthropometric studies and a quantity of photos should be included with the basic measurements.

As a result of the aforementioned studies, initial prototype lasts and boots were fabricated for evaluation. This evaluation was conducted 21-22 January 1964 at Ft. Bragg, North Carolina and Ft. Benning, Georgia on the feet of Thai and Vietnamese personnel stationed at these two installations. This preliminary evaluation indicated that the last and boots were suitable, and accordingly a production quantity of both lasts and test boots (120 pair) were fabricated for further field evaluation in Southeast Asia.

THAILAND

The NIABS Project Officer and the contractor representative reported to ARPA R&D Field Unit, Bangkok, Thailand on 24 March 1965. The following day the Thai Quartermaster General (Major General Fua Riddhagni) and ARPA personnel were briefed on the purpose of the mission. Specific requests for assistance in various areas were presented to the Quartermaster General who immediately guaranteed full assistance wherever required.

The test boots and lasts Air Expressed by MATS to Bangkok were inspected and found to be in good condition.

March 26-29 was spent observing the various operations and methods of manufacturing combat boots at the Royal Thai Army Shoe Factory. While many of the operations could be considered obsolete when compared to U. S. production techniques, the fabrication of the footwear is very good. The quality of the material, i.e., leather, rubber and boot components, leaves much to be desired. The rubber outsoles and heels appeared to be the poorest components in the boots. Because of the poor quality of the rubber soles and heels a visit was made to the rubber manufacturing plant. The equipment at this installation was older than that observed in the shoe factory. Predicated on the above, it is not surprising that the rubber soles and heels are the weakest components of the boot.

The manager of the rubber factory, a Thai Colonel in the Ordnance Corps, stated that he had visited the United States on one occasion and had spent considerable time in a rubber plant (name unknown) and upon his return to Thailand had strongly urged and recommended that new equipment be purchased. However, up to this time the factory has not been able to obtain this new equipment. (This problem of out-dated equipment is further covered in attached informal report written to the Program Manager, Combat Equipment Division, Military R&D Center, Ministry of Defense, Government of Thailand while the Project Officer was in Thailand.)

On 30 March the combination Thai Tannery/Shoe Factory was visited. The factory is tanning approximately 2000 - 3000 lb. daily of cattlehide and buffalo hide. The cattlehide is used for upper stock and the buffalo for sole leather stock. All the sole leather is vegetable-tanned and upper leather chrome-retanned. They use mildew inhibitor during the tanning process in a very limited quantity. (The use of mildew inhibitor was recommended by Dr. S. J. Kennedy of Natick Laboratories during his visit to Thailand and is contained in his Final Report covering 1 Jun - 29 Nov 1963.) The hides are purchased from local farmers and good hides are difficult to obtain. There is no actual grading of the hides.

A visit was made to Camp Narai, Lopburi on 1-2 April. This airborne training company had approximately 3000 troops and over



Crack
across
ball of
outsole



Inseam
Stitching
broken
from toe
to ball

half of the troops were made available for examination of their boots. Over 50% of the boots worn by these men were considered to be in condition that would warrant their being salvaged. Some of the deficiencies noted are as follows:

- a. Large chunks of rubber off heel
- b. Inseam stitching broken from toe to ball
- c. Welt broken and missing
- d. Heel seat lasting broken (heel and midsole loose)
- e. Holes in leather across vamp and outside ball
- f. Crack across ball of outsole

The men interviewed complained primarily about poor durability of the boot, with lack of comfort being a secondary complaint. However, all agreed that there was insufficient room in the outside ball area of the boot and excessive leather in the boot quarters. The sockgear worn by the troops were in extremely poor condition. The majority of the men were wearing cotton socks and no one seemed to know the type socks required to be worn with boots.

On 5 April a visit was made to Bata Shoe Company, located outside the city limits of Bangkok. This is an excellent shoe manufacturing plant and is capable of producing quality rubber/canvas footwear in large quantity. In addition, rubber soles and heels could be produced at this plant for use on the leather boot. It was felt by both ARPA and Thai Quartermaster personnel that attempts should be made to reach a cost agreement for soles and heels, and to procure from this plant.

The undersigned, contractor representative, and assisting Thai personnel, traveled on 6 April to Camp Dhanataraja, Pran Buri. This is the only recruit training center in Thailand and has approximately 14,000 troops. The troops receive eight weeks extensive basic training similar to the type training given U.S. troops. The fit and wear trial of the new combat boot was conducted at this training center. The actual fit trial was initiated on 7 April and completed 9 April. Approximately 450 troops were fit tested. During the fitting, foot length and ball girth measurements were recorded. In addition, a notation was made of the size boot presently worn by the test subject. The initial "try-on" size was determined by the length and ball measurement.

The following observations were made during the fitting of the trial sizes of the boots:

a. More room was needed at the outside ball area extending from the fifth metatarsal to the instep. This would require a minor modification of the location of the wood on the last to build up the wood over this area.

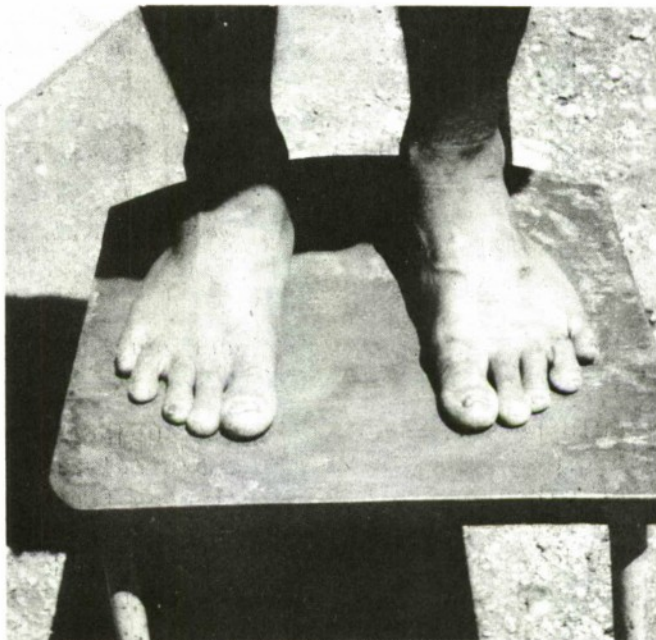
b. It was apparent that the way the shoes were fitting, the size and width designations that had been assigned should be changed. Accordingly, the lasts were sized down one size; i.e., the 7s were redesignated 6s and the "R" width was dropped

since it was apparent that the Wide and Extra Wide widths would accommodate all the population.

c. The upper patterns should be modified to have the eyelet rows fit straight up the front of the leg.

Inasmuch as the above observations were noted on a majority of the test subjects, it was considered that a trend had been established and additional fitting was not required.

Predicated on the above, 45 troops were issued boots on 9 April for accelerated wear trial. In order to maintain control during the wear phase all test subjects were selected from Company A, 1st Battalion, 1st Regiment. Prior to actual issue of the test boots each test subject's feet were photographed for future reference. The negative number of the photograph was recorded on the soldier's test form. In the event any abnormalities occurred during test the individual's foot photograph could be studied. Photographs were also taken to illustrate the width of the forepart, muscle protrusion along outside ball, thong space between first and second toe.



Muscle Protrusion Along
Outside Ball



Thong Space Between 1st and 2nd Toe

It should be noted that the test subjects considered it an honor to participate in the test. Accordingly, it became necessary to check the feet carefully to avoid including test subjects who actually were not well fitted but who wanted to participate in the test, or when "borderline" cases of fit were included in the test; this was done deliberately to insure check of the adequacy of the last where the fit was barely adequate.

The actual wear phase of the test was conducted from 9 April through 17 April. During this period the troops participated in several forced marches (10-15 miles) in addition to normal training activities, such as range firing and field problems. The undersigned accompanied the troops on all field problems and forced marches. The subjects' feet were periodically checked and no foot problems such as erythema, blisters or callouses were recorded. During inspection of the feet the test boots were also studied for durability. At the conclusion of the wear trial an important observation regarding durability was noted. Prior to leaving Bangkok to conduct the tests described above, it was decided to fabricate six pair of test boots over the new last at the Royal Thai Quartermaster Shoe Factory, utilizing the materials available at the factory.

The boots were considered to be well made in regard to "workmanship." However, at the conclusion of the test the boots

made at the Thai factory were beginning to show definite signs of wear on the sole and heel, whereas the U.S.-made boots had very little evidence of wear on the bottom. This appeared to substantiate a need for more review of the quality control exercised in the manufacture of rubber soles and heels used on the Thai Army Boots.

At the conclusion of the test the undersigned and the contractor representative, along with Thai personnel, interviewed each test subject regarding fit, comfort and acceptability of the item. Comparison of the test subjects' responses to the undersigned and Thai personnel showed that they were the same. The general opinion among the troops was that the boot was "very comfortable," "lighter in weight" and "looked better." The wear trial clearly demonstrated that the new last was both acceptable and a good fitting last. Several subjects actually claimed that they obtained higher scores on the firing range because of the new boot! A few AWOL personnel were very proud in showing new boots to their folks during the time they were at home.

April 18-20 was spent at ARPA Field Unit, Bangkok, reviewing and analyzing the data and preparing informal report to Program Manager. (Copy attached as Annex A)

SAIGON, VIETNAM

Arrived Saigon, 21 April, and briefed Colonel B. F. Hardaway, Chief, ARPA, R&D Field Unit-Vietnam, and Lt. Colonel V. M. Stone, Chief, QM Branch, Director of Army MAP Logistics, MACV. It was stated that due to very tight training schedule of Vietnamese troops a wear trial of boots could not be conducted. Accordingly, an accelerated fit trial was conducted 22-23 April at Camp Quang Trung.

Camp Quang Trung is located approximately 10 miles north of Saigon. It is an infantry training center with approximately 12,000 troops.

Colonel R. B. Cobb, Infantry, USA, Chief U.S. Advisor, assisted the Project Officer in obtaining the necessary men for fit study.

One hundred and ten (110) troopers were processed through the fit study and the following observations were made:

a. Minor modifications to the last at outside ball (flex) area, extending from fifth metatarsal to instep (similar to the observations made in Thailand).

b. Eliminate "R" width in its entirety.

c. Change upper pattern so eye row will fit straight and reduce circumference of the upper (quarter) to provide improved lacing adjustment.

The similarity of these observations to those made in Thailand are to be noted. The basic foot shapes of the Thai and Vietnamese are similar. The fit revealed, however, that the Vietnamese peak tariff demand (length) occurred in the 5, 5½, 6 range whereas the Thais occurred in the 7, 7½, 8 range. The width requirements were the same in both countries.

On 23 April Colonel Cobb escorted the Project Officer to observe footwear at the various phases of training, i.e., 3, 5, 7, 9, 12 weeks. The troops at this Center undergo an intensive 12-week training exercise.

The majority of the troops were wearing the canvas/rubber jungle sneaker manufactured in Japan. However, the last was not the proper last for these troops, and the troops interviewed expressed extreme dissatisfaction with this footwear. Many of the men had their feet swathed in bandages due to excessive blisters. In addition, 50% of the footwear was in a condition which would warrant salvage.

On 24 April visits were made to Bata Shoe Co. and Hop-On Shoe & Last Manufacturing Company, Saigon. The Bata plant was very

modern and "up-to-date" and was producing excellent footwear. It is considered that they would be capable of producing a rubber/canvas boot over the newly developed last. The Hop-On Company has a small plant and is equipped to make simpler types of canvas/rubber footwear. However, this company had a last-making machine and could fabricate wooden lasts in limited quantities. This facility could be used for making lasts in the event that leather footwear were to be made in Vietnam, but is not able to produce the metal lasts that would be needed for the production of rubber/canvas footwear.

JAPAN

During the stay in Japan, 25-27 April, visits were made to U.S. Army Procurement Agency and to last manufacturers. Visits were made to last manufacturers to ascertain the capabilities of Japanese last manufacturers to produce the newly developed Vietnamese/Thailand last for the indigenous forces if the necessity arose.

The KK Katatora Last Manufacturer, Yokahama, is a very modern up-to-date plant and produces excellent lasts. Their production capacity is equal to the largest last manufacturer in the United States. The plant manager (Mr. Kubota) indicated an interest in producing production lasts for the new boot and this information was provided to the U.S. Army Procurement Agency, Japan.

UNITED STATES

Phase I of contract was continued upon NLABS Project Officer's and contractor representative's return to the United States on 30 April and completed on 20 September 1965.

In accordance with the findings from the trial in Thailand and Vietnam, a change in the contract was made to provide for modification of the master lasts to relocate the wood on the last as was found desirable in the fitting test.

In accordance with the terms of the contract, the contractor furnished the following upon completion of the modifications which were agreed upon:

Last Master Models

<u>Width</u>	<u>Sizes</u>	<u>Quantity</u>
(W) Wide	3 thru 10	2 ea-right foot only
(XW) Extra Wide	3 thru 10	2 ea-right foot only

Last Patterns

3 sets all sizes and widths

Boot Upper Patterns

3 sets all sizes and widths

Final Report (Jones & Vining) with recommendations
(Copy attached as Annex B)

Authorization to proceed with Phase II of contract was granted to contractor in October 1965. This phase required the fabrication of production lasts in a tariff of sizes for use in the production of boots and ultimately for shipment to Vietnam and Thailand. In accordance with this part of the contract, the contractor provided the following production lasts:

Production Last Sizes Supplied by the Contractor

	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>Total</u>
Wide	12	18	18	24	24	12	12	120
Extra Wide	12	18	18	24	24	12	12	120

These lasts together with the last patterns and boot upper patterns and turning models procured under Phase I and II, were forwarded to Thailand and Vietnam, U.S. Military Assistance Command, during February 1966. One hundred and twenty were sent to Thailand and one hundred and twenty to Vietnam.

In addition, at the request of the Chief, MACV, last models and patterns for the all-leather welt combat boot and one complete set of master models and patterns for the canvas/rubber combat boot were forwarded to Vietnam during October 1965.

4. Conclusions

Based upon the fitting trials carried out in Vietnam and Thailand, it is concluded that:

a. The new V/T-1 last will adequately fit 99% of the Vietnamese/Thai military personnel if reasonably good foot measuring and fitting practices are exercised. In each country, however, a fitting manual similar to the U.S. Army Quartermaster Interim Training Circular No. 14, "Fitting of Footwear," will be needed to provide instructions in the proper fitting of footwear.

b. The last as developed is adequate for the production of leather footwear; where rubber/canvas footwear is to be produced, the modification of this last, which was furnished to Vietnam, should be used as a basis for production of turning models, patterns, and production lasts.

c. Requirements for production lasts for either leather or canvas/rubber footwear should probably be obtained in Japan or the United States since neither Thailand or Vietnam are actually prepared to manufacture these lasts locally.

d. Leather combat boots of good quality can be produced to the required extent in Thailand but not in Vietnam. Rubber/canvas footwear can be produced in Vietnam and Thailand.

e. Last-producing facilities in Japan are excellent.

f. Close surveillance should be maintained on initial production of lasts and boots both in Thailand and Vietnam.

5. Recommendations

It is recommended that:

a. Samples of any lasts produced for Thailand or Vietnamese personnel, based upon the Swain/McLean last developed under this project, be submitted to the U. S. Army Natick Laboratories for checking as to sizes prior to large scale production of the lasts.

b. Samples of footwear fabricated over these last models, similarly, should be forwarded to the Natick Laboratories for examination. Such action would permit our validating the production lasts from these models and their use in footwear to insure full benefit from the items as developed under this project.

c. Additional last models and lasts for fabrication of canvas/rubber footwear (V/T-2 last) be procured for use by Vietnam and possible use by Thailand.

Bangkok, Thailand
April 19, 1965

Informal Report to the Program Manager
Combat Equipment Division
Military Research and Development Center
Ministry of Defense
Government of Thailand

OBJECTIVE: Development of Functional Footwear Lasts for the
Thai Military

PREPARED BY: Douglas S. Swain
Footwear Technologist
U. S. Army Natick Laboratories

Richard J. McLean
Technical Sales Manager
Jones & Vining, Incorporated
Brockton, Massachusetts

ARPA Order 267, dated 30 April 1964, with Amendment 11, to U. S. Army Natick Laboratories called for development of satisfactory military boot lasts for Southeast Asian forces. Natick subcontracted with the Jones & Vining, Inc., of Brockton, Massachusetts, to design the last. The contract with this firm has entailed the following:

1. Review and analysis of the anthropometric data collected by Dr. Robert White, Natick Anthropologist, in Thailand and Vietnam;
2. Study of plaster casts of Thai feet;
3. A visit to Fort Bragg, North Carolina, and Fort Benning, Georgia, where the feet of Thai personnel on duty in the U.S. were examined and small-scale fitting trials conducted;
4. Production of a complete set of test lasts and fabrication of 120 pairs of test boots over these lasts for field evaluation in Southeast Asia.

The new lasts, developed for the Royal Thai armed forces and based on Dr. White's anthropometric measurements, required a thorough field testing, as distribution of the wood on the lasts is as critical as the actual measurements in shaping a boot. Accordingly, a technical representative of the U. S. Army Natick Labs and a technical representative of the last manufacturer have conducted a fit and wear test on Thai military personnel stationed at the RTA Replacement Training Center, Pranburi. Results of this test and recommendations are furnished in this two-part report; the first part is a diary of the technical team's activities in Thailand. The second part of the report is an overall evaluation of Thailand's combat footwear problem.

Part I - Diary of Fit and Wear Tests of Southeast Asia

- April 6th. Left Bangkok with Major Tavorn Ponechana, Chief, RTA QM Shoe Factory, to conduct fit and wear tests at RTA Replacement Training Center, Pranburi.
- April 7th. Processed soldiers at the rate of 150 per day, taking foot measurements, and selecting proper size of boot for each soldier. Accurate records were kept of each fitting. Also noted were present boot size and fit.
- April 9th. Completed fit phase after processing 409 soldiers. A satisfactory fit was achieved with over 95% of the subjects. A minor modification of the lasts will be made in the ball area, as the Thai tends to be exceptionally wide in this area of his

foot. This modification will be made at the contractor's plant in Brockton, Massachusetts. It is believed that with the above minor modification a correct fit can be achieved on 99% of the Thai military.

- April 10th. Test boots were issued to 43 subjects, with instructions to wear and report any difficulties. In addition, photographs were taken of each test subject's feet.
- April 13th. Test subjects returned to training schedule and were observed in training. The schedule consisted of drilling, hiking, range firing, and a forced march. Daily checks were made on test subject's fit, and their feet were checked for any blisters, sores, etc. In addition, each subject was questioned regarding the boot.
- April 16th. A final check of each subject's fit and his feet for any signs of blisters, sores, etc. No adverse conditions were found; 43 test subjects reported boots very comfortable and better fitting than present RTA issue combat boot. They also liked the new, lower quarter pattern better than the present boot, as it was easier to lace and more comfortable. Most test subjects felt boots were lighter in weight than present boots. The plain vamp (no leather toe cap) was also liked by the troops. This design is the same as the new U.S. Army Military V boot, is less expensive to manufacture, and is more durable than a boot with a stitched-on toe cap.

Part II - Overall Evaluation of Problem

Problem:

The Thai military does not have a boot which is serviceable enough for field wear.

Discussion:

On Wednesday, March 24th, Mr. Swain and Mr. McLean reported to Lt. Colonel Eaton and Colonel Sawang Thestham, U.S. and Thai Combat Equipment Program Managers, respectively. It was decided that before initial fit and wear tests were conducted, Mr. Swain and Mr. McLean should become familiar with all aspects of Thai military footwear production, and a visit to the RTA QM military footwear factory was arranged by the Quartermaster General. After

inspection of the facility, the following recommendations were made:

1. Inspection of present lasts showed them unsuitable for production of military footwear, as the lasts were swollen from the excessive moisture conditions in Southeast Asia. Insteps were built up with leather and were not uniform. Lasts were not U. S. Munson but copies -- and not true ones -- obtained from Germany.

2. It is recommended that before any new last is adopted and manufactured, serious consideration be given to the use of plastic. It would remain dimensionally stable and would not be affected by the elements.

3. The leather was found to be an inferior grade and was also found to contain no mildew inhibitor, as was discussed by Dr. S. J. Kennedy, Natick Labs, in his Preliminary Evaluation of the Individual Clothing and Equipment of the Royal Thai Army, dated 1 July 1963 (recommendation 7).

4. Threads used in manufacturing were judged insufficient for use in Southeast Asia. Synthetic fibre thread should be used for all stitching, as recommended in Kennedy report (recommendation 6).

5. The rubber soles and heels were found to be of poorest quality. A complete and separate investigation of this critical aspect of the Thai boot problem is recommended, as major corrective action is indicated. U. S. and Japanese sources for premolded soles and heels could also be considered.

On March 31 visited Thai tannery with Lt. Colonel Eaton and Colonel Sawang.

1. Tannery found to be excellent in all aspects of manufacturing. Mildew inhibitor is not being used, however. Observed hand-wiping of skins to remove mildew.

2. This problem can be overcome immediately, however. Soles and heels to specified standards can be produced from outside sources until such time as the RTA facility's antiquated equipment can be improved. Otherwise, arrangements can be made to replace the factory permanently with private suppliers.

3. Bata Shoe Company, Bangkok, has a modern plant which can produce combat boot soles and heels to specifications.

4. Bata also has a modern vulcanization plant and can produce up to 2000 pairs per day. This should be considered as a source of jungle boots if the need arises.

5. Consideration could also be given to U.S. and Japanese sources for premolded soles and heels.

Conclusions and Recommendations:

It is recommended by Mr. Swain and Mr. McLean that, following the aforementioned minor modification, the Southeast Asia last be adopted by the Thai military authorities. It will give a more exact fit and will eliminate 30% of the current boot problems.

It is further recommended that the problem of enhancing durability of the rubber sole and heel be given priority attention, as this is responsible for 50% of the overall boot problems.

It is felt that the leather and thread failures constitute perhaps 10% of the boot problems.

Finally, 10% of the current problems rests with the highly decentralized manufacturing of the boot components and the attendant dissipation of authority and responsibility for its quality. Regardless of how much time and money are invested in lasts, materials, technical analyses, or new equipment, the boot problem is not likely to be solved until corrective action is taken in the management area.

Douglas S. Swain

Richard J. McLean

JONES & VINING, INCORPORATED
LAST MANUFACTURERS
108 Sawtell Avenue
Brockton, Mass. 02403

November 4, 1965

Director
Advanced Research Projects Agency
Washington, D. C.

Gentlemen:

FINAL REPORT

Order No. 267, Amend. #6	Contract No. DA 19-129-AMC-485(N)
Program Code No. ARPA #267 Amend. #11	Contract Exp. Date: May 4, 1965

Jones & Vining, Inc.	Richard J. McLean
Date of Contract: Nov. 4, 1964	Last Development of Thai and Viet Footwear

Amount: \$39,708.22 - Modification dated September 24, 1965

All work required under Phase I of Subject Contract (including modifications #1 dated 8 Jan 1965, #2 dated 9 Apr 1965 and #3 dated 24 Sept 1965) has been completed and all items listed have been delivered to the Government (U.S. Army Natick Laboratories).

A. Recommendations

a. It is recommended that adoption of the V.T. last be made as soon as is practical by the Thai and Vietnamese military.

b. These V.T. Master Models incorporate the anthropometric measurements of the Thai and Viet feet provided by Government (U. S. Natick Labs).

c. Wear and/or fit tests were conducted under Phase I of contract in both Thailand and Viet, results of which showed that with

a minor modification (which has been accomplished) approximately a 99% fit can be achieved. (See attachment Informal Report dated 19 Apr 1965.)

d. The approved models should henceforth be identified as the V-T (Viet-Thai) Last.

e. The initial procurement(s) for the V-T production lasts should be made in the continental U. S. This recommendation is predicated on the fact that no last production facilities are available in either Thailand or Vietnam.

f. A quantity of V-T production lasts and upper boot patterns should be provided to the Thai Government for the manufacture of leather welt combat boots, and that all existing lasts for same be destroyed. It is not recommended that a quantity of V-T production lasts be supplied the Vietnamese Government as leather combat boot manufacturing facilities are not presently available.

Note: It should be noted that the Master Models developed under this contract (DA 19-129-AMC-485(N)) are for the production of Lea Welt Combat Boots Only, and are not suitable for producing Rubber/Canvas footwear. Production of Rubber/Canvas footwear will require the development of new designed last models and patterns. It should be further noted that both countries (Thailand and Vietnam) possess the necessary facilities for producing Rubber/Canvas footwear (i. e., Bata Shoe Co.).

g. Close surveillance should be maintained by the U. S. Government during introduction of this new last and boot into the Vietnam and Thai production facilities.

h. The contractor wishes to go on record as being willing to produce technical assistance (on a consulting basis) for either country (Thai-Viet) should such an occasion arise during introduction and production of the V-T boot.

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13. ABSTRACT			
<p>This report covers Phase II of work accomplished by the U. S. Army Natick Laboratories, Natick, Massachusetts under Advanced Research Project Agency (ARPA) Order No. 267, Amendment 11 on "The Development of a Combat Boot Last for Thai and Vietnamese Military Forces."</p> <p>The program was a joint venture conducted with anthropometric data on Thai and Vietnamese feet originating at the Natick Laboratories, and preliminary tests of lasts and footwear models developed from this study by Jones and Vining, Inc., Brockton, Massachusetts.</p> <p>The Project Officer on this program from the Natick Laboratories, and the representative from Jones and Vining, Inc., were in Thailand and Vietnam from 24 March to 24 April, 1965 at which time they conducted fit and wear tests of combat boots manufactured over the newly-developed last.</p> <p>The tests showed that 99 percent of the Vietnamese/Thai military personnel could be adequately fitted using the new last with minor modifications, which were made. Models and equipment to fabricate the boots were provided to Thailand and Vietnam, U. S. Military Assistance Command.</p>			

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Prototypes	9					
Boots	9					
Combat Footwear	4		4			
Thai army	4		4			
Vietnamese army	4		4			
Fabrication			8			
Equipment			9			
Patterns			9			
Lasts	9		9			
V-T (Viet-Thai) last			9			
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